

**Amendment and Response**

Applicant: Mark Hirst et al.  
Serial No.: 10/689,464  
Filed: October 20, 2003  
Docket No.: 200309601-1  
Title: INDICATING SYSTEM

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**IN THE SPECIFICATION**

Please replace the paragraph beginning on page 1, line 18 with the following rewritten paragraph:

Electrophotographic imaging devices, such as laser printers, fax machines, and photocopiers, are designed to produce an image on a print media, such as a sheet of copy paper. Electrostatic imaging devices generally include a photoconductive element that is selectively illuminated by a scanned laser beam or a-light emitting diode arrays in response to a-data representative of a desired image that is to be produced, wherein the incident light generates an electrostatic copy of the desired image on the photoconductive element. The electrostatic copy is then developed by first exposing the photoconductive element to toner powder that adheres to the charged portions of the photoconductive element and subsequently transferring the toner ~~power-powder~~ from the photoconductive element to the print media. The “loose” toner powder is then fused to the print media by a fuser unit.

Please replace the paragraph beginning on page 1, line 29 with the following rewritten paragraph:

Fuser units typically employ a combination of heat and pressure to fuse the toner powder to the print material. One common type of fusing unit comprises a pair of opposing rollers that form a fusing nip, with one roller serving as a fuser roller and the other roller serving as a-an idler pressure roller. By convention, the fuser roller is generally the roller that contacts the ~~un-fused~~unfused toner and is the roller having the higher temperature if there is a temperature differential between the rollers, and the idler pressure roller applies pressure at the fusing nip to hold the print media in contact with the fuser roller. The fuser roller is generally heated while the idler pressure roller may or may not be heated.

Please replace the paragraph beginning on page 2, line 4 with the following rewritten paragraph:

To fuse the loose toner to the-print material, the print material is fed through the fusing nip at which point the fuser roller melts the loose toner and permanently affixes it to the print material. Fuser units are generally maintained at temperatures between 150° C and 200° C in order to properly fuse the loose toner to the print material. As a result, fusing units

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store a large amount of heat energy and can potentially continue to do so long after the associated imaging device is powered-off. In some instances, the heat energy stored in the fuser unit can be so large that some surfaces of the fuser unit can remain at very high temperatures for several tens of minutes, potentially even after the fuser unit is removed from the imaging device.

Please replace the paragraph beginning on page 2, line 22 with the following rewritten paragraph:

One embodiment of the present invention provides an indicating system in a device having a heat emitting member. The indicating system comprises a thermoelectric generator and an indicating device. The thermoelectric generator is adapted to thermally couple to the heat emitting member and configured to convert heat from the heat emitting element-member to electrical energy. The indicating device is powered by the electrical energy and configured to provide indication of when a temperature level of the heat emitting member is above a temperature threshold.

Please replace the paragraph beginning on page 3, line 28 with the following rewritten paragraph:

In one embodiment, indicating system 32 includes a heat sink 42 adapted to and positioned so as to be thermally coupled to thermoelectric generator 36. In one embodiment, thermoelectric generator 36 is mechanically coupled to heat emitting member 34. In one embodiment, indicating device 38 comprises a light emitting diode (LED). In one embodiment, the LED is configured to blink at a frequency substantially equal to a frequency at which the human visual response to flicker is most sensitive. In one embodiment, indicating device 38 further includes a warning label illuminated by light from the LED. In one embodiment, the warning label comprises a polycarbonate label having light transmitting characteristics, commonly referred to a “light pipe”, such that when light from the LED shines into the label’s edge it is distributed throughout the label so as to illuminate the label in a substantially even fashion.

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Please replace the paragraph beginning on page 4, line 8 with the following rewritten paragraph:

Indicating system 32 provides a more effective warning that a heat emitting member 34 may be at a potentially harmful temperature level than conventional techniques employing traditional non-illuminated labels only. Additionally, if the heat emitting member 34 is part of a host device having a power supply, indicating system 32 provides such indication even if electrical power to the host device is lost or if the heat emitting element-member 34 is removed from the host device. Furthermore, when the heat emitting member 34 is part of a host device having a power supply, indicating system 32 can be utilized without adding cost for an additional connector to provide electrical power to the indicating system 32.

Please replace the paragraph beginning on page 4, line 31 with the following rewritten paragraph:

Figure 2 illustrates at 50, one embodiment of indicating system 32 wherein thermoelectric generator 36 comprises a Peltier device 52, operating in the Seebeck mode to generate an output voltage 54 to power indicating device 38. Peltier device 52 comprises a plurality of p-doped semiconductor segments 55 and a plurality of n-doped semiconductor segments 56, each segment having a first and a second end. The p-doped segments 55 create an excess of electrons, while the n-doped segments 56 create a deficiency of electrons. The p-doped segments 55 and n-doped segments 56 are connected in an alternating series fashion, with their first ends connected by a first plurality of conductor segments 58 and their second ends connected by a second plurality of conductor segments 60, wherein the first and second pluralities of conductor segments 58 and 60 comprise an electrically conductive material such as copper. The first and last conductor segment of the second plurality of conductor segments 60 are connected to a pair of wire 62 to provide output voltage 54 at a pair of output terminals 64 and 66. Indicating device 38 is coupled across terminals 64 and 66 and operated by output voltage 54.

Please replace the paragraph beginning on page 5, line 15 with the following rewritten paragraph:

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The first plurality of conductor segments 58 is coupled to a hot junction 68 and the second plurality of conductor segments 60 is coupled to a cold junction 70. Hot junction 68 and cold junction 70 comprise a material that is highly thermally conductive, but electrically non-conductive, including a ceramic material such as alumina or aluminum nitride. Hot junction 68 is thermally coupled to heat emitting member 34 and cold junction 70 is thermally coupled to a heat sink 72, which is in contact with air 74. In one embodiment, the thermoelectric generator ~~40-36~~ is mechanically coupled to heat emitting member 34 and to heat sink 72. Heat emitting member 34 serves as a heat source, transferring heat 71 to hot junction 68, while heat sink 72 transfers heat 71 from cold junction 70 to air 74.

Please replace the paragraph beginning on page 6, line 1 with the following rewritten paragraph:

Figure 3 illustrates one exemplary embodiment of a laser printer 80 in accordance with the present invention. Laser printer 80 includes a fuser unit 94 having an indicating system that converts heat emitted by the fuser unit 94 to electrical energy to power an indicating device 38 when the temperature of the fuser unit 94 is at a potentially harmful level. Laser printer 80 includes a laser scanning unit 82, a photoconductive drum 84, a charging station 85, a toner hopper 86, a developer roller 88, a paper source 90, a discharge lamp 92, and ~~a~~the fuser unit 94 having an integral indicating system 32 according to the present invention. Fuser unit 94 further includes a pair of opposing platen rollers 96 that form a fusing nip 98, with one roller being a fuser roller 100 and the other being an idler pressure roller 102.

Please replace the paragraph beginning on page 6, line 12 with the following rewritten paragraph:

To produce an image, the surface of photoconductive drum 84 is given a total positive charge by charging station 85. Laser scanning unit 82 then selectively illuminates photoconductive drum 84 with a light beam 87 that is representative of a desired image to be produced. As photoconductive drum 84 rotates, the incident light beam 87 discharges the surface of photoconductive drum 84 and essentially creates an electrostatic copy of the

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desired image on the surface of photoconductive drum 84. While photoconductive drum 84 rotates, developer roller 88 applies toner powder from toner hopper 86 to the surface of photoconductive drum 84, whereby the “loose” toner ~~power~~powder adheres to the electrostatic copy of the image on the drum’s surface. A piece of copy paper is fed from paper source 90 along a paper path 104, and the loose toner powder in the form of the desired image is transferred from the surface of the photoconductive drum 84 to a surface of the copy paper as the copy paper is fed past the photoconductive drum 84. Discharge lamp 92 “erases” the electrostatic copy of the desired image from the surface of photoconductive drum 84.

Please replace the paragraph beginning on page 7, line 10 with the following rewritten paragraph:

Thermoelectric generator 36 converts temperature gradient 76 to an output voltage provided to indicating device 38 via wires 62. In one embodiment, indicating device 38 comprises a light emitting diode (LED) 108 and a warning label ~~100~~110. LED 108 is coupled to wires 62 and powered by the output voltage and illuminates warning label ~~100~~110. Warning label 110 comprises a polycarbonate label adhered to housing 106 that is configured as a light pipe, as described above, to evenly illuminate warning label ~~108~~110 with light from LED 108.

Please replace the paragraph beginning on page 7, line 18 with the following rewritten paragraph:

In one embodiment, LED 108 is configured to blink at a 4 Hz rate to further enhance the effectiveness of indicating device 38. In practice, the blink rate of LED 108 would be near the center point of blink rates at which human perception to light flicker is greatest. For effective indicator operation, the blink rate, or frequency, should be between 0.5 Hz and 15 Hz. Lower blink rates require less power and reduce the required size of thermoelectric generator 36. In one embodiment, to further minimize power consumption, LED 108 could be powered for only a small portion of the blink. For example, given a blink rate of 4 Hz, which yields a time period of 0.25 seconds, the LED 108 could be powered for 0.1 seconds and off for the remaining 0.15 seconds of the blink. This would further reduce average power

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requirements by approximately 60% ( $0.15 \div 0.25$ ). In the case of a blink rate of 2 Hz, which yields a period of 0.5 seconds, if the LED 108 were powered for 0.1 seconds, the power consumption would be reduced by 80% over the power required for continuous operation of the LED 108. This allows the peak power of the LED 108 to be much higher, making warning label 110 much brighter and further improving the effectiveness of indicating systems-system 32.